MS-E2177 - Seminar on Case Studies in Operations Research

Cost-Efficient Defence Against Unmanned Aerial Systems

Interim report

Case Group Patria

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1 Changes in project scope and objectives

The scope of our project and the objectives have remained generally similar. Our central objective is to identify cost-effective methods for protecting a company-sized troop against threats of unmanned aerial systems.

The threats were decided to be a squadron formed by multiple multicopters (MC) and fixed-wing (FW) drones with an average ratio of four to one between the respective drone types. Additional environmental variables and effects may be added to the model such as applying restrictions of Finnish landscape and the day-night cycle. Aside from this there are no notable changes to the project plan.

2 Project status

The project has progressed well and it is currently on schedule determined for the project plan. The updated schedule is shown in figure 1.

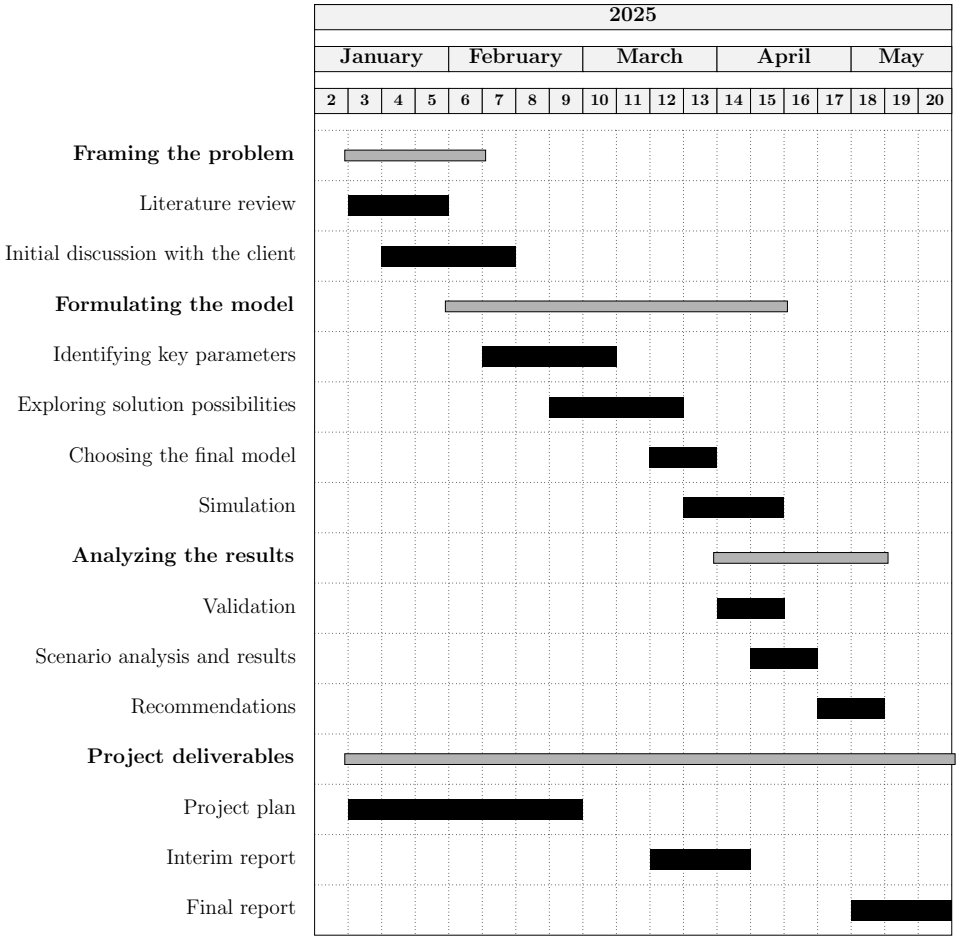

Figure 1: Updated project schedule

Small updates were done for the working periods of simulation to better reflect the workflow.

2.1 Completed tasks

Modeling of the performance of detectors and effectors is completed. This was done by constructing probabilistic distributions based on percentiles provided by experts at Patria. Simulation of

the basic model of one vehicle with effectors is functioning. There are some simulation results for some placeholder values chosen by the group for the simplified case.

2.2 Current tasks

Currently the simulation script is being developed further towards the goals of the project to allow for simulation of company-sized troops and additional environmental variables.

2.3 Remaining tasks

There are two notable tasks that will be considered. Firstly, it has to be considered whether all combinations are necessary to consider within the simulation. The amount of combinations with Monte Carlo -simulation structure requires a massive amount of simulations that need to be run. For example having all the effectors on every vehicle is not reasonable considering cost-effectiveness so limiting the amount of effectors might be a reasonable limitation. Lowering the amount of simulations improves the scalability of the model along with being able to find results faster.

Secondly, a measurement of cost-effectiveness is being considered currently. While it may be hard to come up with a single best possible option, it is required to have some measurement on of how good a combination of effectors is.

3 Current risk management plan

The risk management plan (table 1) has stayed relatively unchanged, however, some modifications have been made. Mainly some descriptions and effects of certain risks have been clarified.

Table 1: Risks associated with the project.

Risk	**Likelihood**	**Impact**	**Effect**	**Mitigation**
Scope too broadly defined	Low	High	The final model does not capture the problem.	Clearly define project scope with client early on. Regular scope reviews.
Communication challenges with the client	Low	High	Lack of feedback. End product may not meet client expectations.	Taking initiative in actively communicating. Regular meetings.
Overly complex mathematical model	Medium	High	Model may be computationally infeasible or difficult to interpret for decision-making.	Align the model complexity with project needs. Prioritize interpretability and feasibility.
Team member inactivity	Low	Medium	Project is not completed on time due to increased workload for other team members	Regular meetings. Good communication and scheduling of project tasks
Insufficient public data	Medium	Medium	Model does not accurately reflect cost-effectiveness in reality	Consulting the client about the assumptions. Using easily adjustable parameters
Unrealistic threat assumptions	Medium	High	The model may not simulate real-world UAV threats accurately. An unnecessarily good solution is found.	Validate assumptions with the experts at the client organization. Use real-world data when possible.